Department of Pesticide Regulation

Mary-Ann Warmerdam
Director

Arnold Schwarzenegger
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October 26, 2006

TO: Interested Parties

SUBJECT: 2006 UPDATE OF VOLATILE ORGANIC COMPOUND EMISSION INVENTORY

The Department of Pesticide Regulation (DPR) has completed the annual volatile organic compound (VOC) emission inventory based on the 2004 pesticide use data for five nonattainment areas in California. These areas are designated as being nonattainment for the federal one-hour ambient air quality standard for ozone. DPR prepared the inventory as part of its commitment to reduce pesticide VOC emissions under the 1994 State Implementation Plan (SIP) for agricultural and commercial structural pesticides.

DPR has continued efforts to improve the accuracy of the emission inventory and the 2004 inventory reflects these efforts. The most significant improvement was the replacement of pesticide product default assumptions with product specific data. In February 2005, DPR required the submission of thermogravimetric analysis data for several hundred pesticide products. Currently, thermogravimetric analysis is the most accurate method for estimating the VOC content of pesticide products. DPR received, evaluated, and incorporated the data for all applicable years of the inventory.

As expected, the 2004 pesticide VOC emission inventory mirrors the 2004 pesticide use report that showed decreases for two areas and increases for the other areas compared to 2003. For the Sacramento Metropolitan and South Coast nonattainment areas, the 2004 pesticide VOC emission inventory continues to meet the targets of the 1994 SIP. The pesticide VOC emission inventory for the San Joaquin Valley, Ventura, and Southeast Desert nonattainment areas does not meet the targets. Additionally, in 2006, a court ordered DPR to achieve a 20 percent VOC reduction from 1991 levels in all nonattainment areas through regulation that must be adopted by 2008. The ruling is on appeal. However, we are taking regulatory steps to achieve our 1994 SIP commitments and comply with the court order.

Bringing the San Joaquin Valley nonattainment area into compliance with our obligations is our highest priority. For several years, the pesticide VOC emission inventory trend for the San Joaquin Valley showed considerable and steady progress toward meeting the reduction goal, and was met in 2001. However, pesticide VOC emissions have increased for the last three years in the San Joaquin Valley and are currently above the reduction goal. For the past three years, DPR has begun the process of identifying regulatory measures to bring the pesticide VOC emissions into compliance with the goals. In 2005, DPR issued a notice to pesticide registrants of products

that contained a high amount of VOCs requiring a plan to reformulate below 20 percent. The notice involved over 700 pesticide products and will be completed soon.

In May 2006, DPR launched a comprehensive initiative to improve air quality by additional regulation of pesticides. The Pesticide Air Initiative will involve a regulatory framework that will enhance DPR's commitment to reduce VOC emissions from agricultural and commercial structural pesticides in nonattainment areas, as outlined in the 1994 SIP. DPR's emphasis on reducing VOC emissions from pesticides will also be done in a way that reduces pesticide toxic risk and drift.

Our primary focus for reducing pesticide VOC emissions will be based on a reduction in VOC emissions from traditional pesticide applications and a shift in pest control practices. To achieve these two goals, DPR will reduce emissions from fumigants (which currently account for about one-fourth of all pesticide pounds applied annually) and complete the reformulation reevaluation process for pesticide products. Regulations to reduce emissions from fumigants will be in place by the end of 2007.

More information on VOCs and DPR's Pesticide Air Initiative is available at <http://www.cdpr.ca.gov/docs/empm/ehap.htm>.

Sincerely,

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M E M O R A N D U M

TO: John S. Sanders
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FROM: Tamara L. Roush, Ph.D *Original signed by Tamara Roush*
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DATE: October 24, 2006

SUBJECT: 2006 UPDATE TO THE PESTICIDE VOC INVENTORY:
ESTIMATED EMISSIONS 1990-2004

I. OVERVIEW

This memorandum summarizes the Department of Pesticide Regulation's (DPR's) 2006 update of estimated pesticide volatile organic compound (VOC) emission data, with particular attention to May-October "ozone season" emissions in California's five non-attainment areas (NAAs). An electronic file containing detailed statewide 1990-2004 data is available by download from DPR's Web page at <http://www.cdpr.ca.gov/docs/pur/vocproj/vocmenu.htm> along with a variety of VOC documentation.

The 1990–2004 annual VOC inventories were recalculated and included three revisions to the procedures used in 2005 (Li and Spurlock 2005). The revisions were 1) adding 11 application sites previously excluded from the VOC inventory and excluding three sites previously included, 2) updating criteria used to identify and exclude consumer products, and 3) re-calculating the default emission potential for products containing sodium tetrathiocarbonate. These revisions are explained in greater detail in Spurlock (2006). Future changes that were not incorporated in this year's calculations involve updates to default emission potentials based on formulation codes and improved estimations of emission potentials based on data from field studies.

Additionally, the 1990 – 2004 VOC inventories incorporate new emission potential data for several hundred products. In February 2005, DPR requested thermogravimetric analysis data for several hundred pesticide products. Thermogravimetric analysis is currently the most accurate method for estimating the VOC content of pesticide products. DPR requested the data for most liquid products included in the inventory that had not been tested previously. The VOC emissions described here incorporate the thermogravimetric analysis data submitted, reviewed, and approved as of August 2006. The delay in publishing this annual report is due to time required to evaluate and incorporate the new data.

The 2004 VOC emissions reported are based on DPR's 2004 pesticide use data, released in January 2006 (DPR, 2006). The NAA attainment goals discussed are those originally described

in the January 8, 1997, Federal Register, page 1170, Emission Reductions (Federal Register, 1997), as well as those described in the relief order issued April, 26, 2006, following the decision in *El Comité Para Bienstar de Earlimart v. Helliker,* 416 F. Supp. 2d 912, (E.D. Cal. 2006). Previously, the 1990 baseline was used to calculate the reduction goals of 12% in the San Joaquin Valley NAA and 20% in each of the other NAAs. Under the court order, the 1991 base year is used, and the goal in each is 20%. (Table 1). For simplicity and ease of comparison with previous reports, most of this document refers to the original goals that use 1990 as the base year and a 12% reduction for San Joaquin Valley.

TABLE 1: 1990 and 1991 May–October (ozone season) pesticide VOC emissions and goal emission rates in NAAs 1–5 reported as tons of total organic gases per day (tpd).

	Original			Court Order	
NAA	**1990 emissions (tpd)**	**Goal emissions (tpd)**	**Goal Year**	**1991 emissions (tpd)**	**Goal emissions (tpd)**
1 - Sacramento Metropolitan	2.876	2.301	2005	3.134	2.507
2 - San Joaquin Valley	22.604	19.892	1999	22.258	17.806
3 - Southeast Desert	1.241	0.993	2007	0.838	0.670
4 - Ventura	4.524	3.619	2005	3.946	3.157
5 - South Coast	10.898	8.718	2010	5.210	4.168

II. 2004 VOC INVENTORY RESULTS BY NON-ATTAINMENT AREA (NAA)

The 2004 VOC emissions were calculated for each non-attainment area and summed according to primary active ingredient, application site, and emission category as defined by the Air Resources Board (ARB). The primary active ingredient is defined as the pesticidal active ingredient present at the highest percentage in a product. If a pesticide product contains 20 percent of active ingredient "A" and 10 percent of active ingredient "B", all estimated emissions from that product are assigned to the primary active ingredient "A". This approach prevents "double-counting" of emissions from products containing two active ingredients. The Air Resources Board defines four VOC emission categories: methyl bromide emissions from agricultural applications, non-methyl bromide emissions from agricultural applications, methyl bromide emissions from structural applications, and non-methyl bromide emissions from structural applications. Emissions were calculated for May – October, the ozone season, and are reported as US tons of total organic gases per day (tpd).

A. NAA 1, Sacramento Metropolitan Area

The emission rate in NAA 1 continues the decreasing trend seen since 2002 and is down 15.3% from the 2003 rate of 1.624 tpd. The 2004 level of 1.376 tpd is well below the 2005 goal emission rate of 2.301 tpd (Figure 1). Molinate and thiobencarb, herbicides used on rice, contributed substantially to NAA 1 emissions (Table 2). The insecticide chlorpyrifos was the second highest contributor at 7.8% of the emissions. Rice was the highest contributing application site with 27.5% of emissions, followed by walnuts at 13.2% (Table 3). Products containing the fumigants 1,3-dichloropropene and methyl bromide accounted for much of the emissions in NAA 1. Agricultural applications contributed to 90.6% of the total emissions, with 85.6% comprised of non-methyl bromide agricultural applications (Table 4).

TABLE 2: Top ten primary active ingredients contributing to 2004 May-October ozone season VOC emissions in NAA 1, the Sacramento Metropolitan Area.

Primary AI	Total product emissions (tons/day)	% of all NAA 1 May - Oct 2004 emissions
MOLINATE	0.198	14.4
CHLORPYRIFOS	0.108	7.8
THIOBENCARB	0.100	7.3
1,3-DICHLOROPROPENE	0.094	6.8
METHYL BROMIDE	0.068	5.0
CYPERMETHRIN	0.065	4.7
COPPER ETHANOLAMINE COMPLEXES, MIXED	0.055	4.0
TRIFLURALIN	0.050	3.6
PROPYLENE OXIDE	0.049	3.5
DIMETHOATE	0.047	3.4

TABLE 3: Top ten pesticide application sites contributing to 2004 May-October ozone season VOC emissions in NAA 1.

Application site	Emissions (tons/day)	% of all NAA 1 May - Oct 2004 emissions
RICE	0.379	27.5
WALNUT	0.182	13.2
STRUCTURAL PEST CONTROL	0.130	9.4
PROCESSING TOMATOES	0.126	9.2
RIGHTS OF WAY	0.090	6.5
COMMODITY FUMIGATION	0.081	5.9
WINE GRAPE	0.071	5.2
ALFALFA	0.054	3.9
SOIL FUMIGATION / PREPLANT	0.037	2.7
LANDSCAPE MAINTENANCE	0.029	2.1

TABLE 4: 2004 May–October VOC emissions in NAA1 by ARB emission inventory classification (tons per day, tpd).

	Agricultural applications	Structural applications
methyl bromide emissions	0.068	0.000
non-methyl bromide emissions	1.178	0.130

B. NAA 2, San Joaquin Valley

The 2004 ozone season NAA 2 emission rate of 25.648 tpd is slightly more than the 24.559 tpd found in 2003, and still greater than rates in 2002 and 2001. Furthermore, this exceeded the 1999 goal of 19.892 tpd by 28.9% (Figure 1). Fumigants accounted for 54.2% of all emissions (Table 5), and carrots, almonds, and cotton were the top three application sites, contributing 38% to emissions (Table 6). These are the same trends as those reported for 2002 and 2003. Almost all of 2004 NAA 2 VOC emissions (98.4%) were attributable to agricultural pesticide uses with the remaining 1.6% from commercial structural pesticide applications. Methyl bromide contributed only 10.6% to the agricultural applications and 3.2% to non-agricultural applications (Table 7).

TABLE 5: Top ten primary active ingredients contributing to 2004 May-October ozone season VOC emissions in NAA 2, the San Joaquin Valley.

Primary AI	Total product emissions (tons/day)	% of all NAA 2 May - Oct 2004 emissions
METAM-SODIUM	5.749	22.4
1,3-DICHLOROPROPENE	4.887	19.1
CHLORPYRIFOS	2.856	11.1
METHYL BROMIDE	2.694	10.5
DIMETHOATE	0.570	2.2
OXYFLUORFEN	0.569	2.2
POTASSIUM N-METHYLDITHIOCARBAMATE	0.565	2.2
GIBBERELLINS	0.515	2.1
ENDOSULFAN	0.515	2.0
ACROLEIN	0.454	1.8

TABLE 6: Top ten pesticide application sites contributing to 2004 May-October ozone season VOC emissions in NAA 2.

Application site	Emissions (tons/day)	% of all NAA 2 May - Oct 2004 emissions
CARROT	3.952	15.4
ALMOND	3.113	12.1
COTTON	2.690	10.5
ORANGE	2.007	7.8
NURSERY OUTDR CONTAINER -FLD GRWN PLANTS	1.779	6.9
GRAPE	1.337	5.2
POTATO	0.985	3.8
WALNUT	0.838	3.3
RIGHTS OF WAY	0.654	2.6
PROCESSING TOMATOES	0.579	2.3

TABLE 7: 2004 May–October VOC emissions in NAA 2 by ARB emission inventory classification (tons per day, tpd).

	Agricultural applications	Structural applications
methyl bromide emissions	2.681	0.013
non-methyl bromide emissions	22.563	0.391

C. NAA 3, Southeast Desert

The 2004 NAA 3 ozone season VOC emissions of 1.506 have not changed much since 2003 (1.559 tpd). Emission rates for this region have generally increased since 1998 and are now 51.7% above the 2007 ozone season target of 0.993 tpd (Figure 1). The fumigants metam-sodium, methyl bromide, 1,3-dichloropropene, and chloropicrin were the top four contributing primary active ingredients, together comprising 82.7% of the NAA 3 emissions (Table 8). Uncultivated agricultural areas accounted for approximately one quarter of all emissions, followed by peppers, carrots, and strawberries (Table 9). Agricultural applications contributed to 94.1% of all emissions. Methyl bromide was more widely used in NAA 3, accounting for 24.8% of emissions from the agricultural applications (Table 10).

TABLE 8: Top ten primary active ingredients contributing to 2004 May-October ozone season VOC emissions in NAA 3, the Southeast Desert.

Primary AI	Total product emissions (tons/day)	% of all NAA 3 May - Oct 2004 emissions
METAM-SODIUM	0.835	55.5
METHYL BROMIDE	0.352	22.4
1,3-DICHLOROPROPENE	0.041	2.7
CHLOROPICRIN	0.031	2.1
PERMETHRIN	0.029	1.9
CHLORPYRIFOS	0.018	1.2
EPTC	0.015	1.0
MEFENOXAM	0.014	0.9
BENSULIDE	0.014	0.9
PENDIMETHALIN	0.011	0.7

TABLE 9: Top ten pesticide application sites contributing to 2004 May-October ozone season VOC emissions in NAA 3.

Application site	Emissions (tons/day)	% of all NAA 3 May - Oct 2004 emissions
UNCULTIVATED AGRICULTURAL AREAS*	0.378	25.1
PEPPERS, FRUITING	0.261	17.3
CARROT	0.181	12.0
STRAWBERRY	0.160	10.7
POTATO	0.128	8.5
STRUCTURAL PEST CONTROL	0.087	5.8
CANTALOUPE	0.053	3.5
TURF / SOD	0.039	2.6
CELERY	0.034	2.2
WATERMELON	0.028	1.8

* Treatment of an area prior to determining which crop will be planted.

TABLE 10: 2004 May–October VOC emissions in NAA 3 by ARB emission inventory classification (tons per day, tpd).

	Agricultural applications	**Structural applications**
methyl bromide emissions	0.352	0.000
non-methyl bromide emissions	1.066	0.088

D. NAA 4, Ventura

Ozone season emissions of 9.506 increased 24.7% over 2003, and exceeded the 2005 target of 3.619 tpd by 97.4% (Figure 1). As in NAA 3 and NAA 2, fumigants contributed to the majority of emissions (Table 11). Strawberry applications produced approximately three quarters of the emissions, and soil fumigations accounted for another 10.5% (Table 12). Only 2.1% of NAA 4 emissions resulted from commercial structural pesticide applications, and methyl bromide emissions comprised over half of the emissions from agricultural applications (Table 13).

TABLE 11: Top ten primary active ingredients contributing to 2004 May-October ozone season VOC emissions in NAA 4, Ventura.

Primary AI	**Total product emissions (tons/day)**	**% of all NAA 4 May - Oct 2004 emissions**
METHYL BROMIDE	4.855	51.1
1,3-DICHLOROPROPENE	2.524	26.5
CHLOROPICRIN	1.001	10.5
METAM-SODIUM	0.457	4.8
PIPERONYL BUTOXIDE	0.178	1.9
CHLORPYRIFOS	0.081	0.9
PETROLEUM OIL, UNCLASSIFIED	0.072	0.8
ABAMECTIN	0.028	0.3
POTASSIUM N-METHYLDITHIOCARBAMATE	0.028	0.3
METALDEHYDE	0.024	0.3

TABLE 12. Top ten pesticide application sites contributing to 2004 May-October ozone season VOC emissions in NAA 4.

Application site	Emissions (tons/day)	% of all NAA 4 May - Oct 2004 emissions
STRAWBERRY	7.060	74.3
SOIL FUMIGATION / PREPLANT	0.997	10.5
TOMATO	0.430	4.5
STRUCTURAL PEST CONTROL	0.198	2.1
LEMON	0.196	2.1
NURSERY OUTDR GRWN CUT FLWRS OR GREENS	0.098	1.0
UNCULTIVATED AGRICULTURAL AREAS	0.094	1.0
TURF / SOD	0.080	0.8
RASPBERRY	0.078	0.8
PEPPERS, FRUITING	0.061	0.6

TABLE 13: 2004 May–October VOC emissions in NAA 4 by ARB emission inventory classification (tons per day, tpd).

	Agricultural applications	Structural applications
methyl bromide emissions	5.135	0.000
non-methyl bromide emissions	4.173	0.198

E. NAA 5, South Coast

At 2.615 tpd, VOC emissions in NAA 5 were slightly lower than those in 2003 (Figure 1), and were far below the 2010 goal emission rate of 8.718 tpd. Methyl bromide, 1,3-dichloropropene, and chloropicrin contributed to 51.7% of emissions (Table 14). Consequently, application sites based heavily on fumigations also accounted for almost all emission production (Table 15). Approximately one third each of emissions in NAA 5 were attributable to methyl bromide agricultural uses, non-methyl bromide agricultural uses, and non-methyl bromide commercial structural uses (Table 16).

TABLE 14: Top ten primary active ingredients contributing to 2004 May-October ozone season VOC emissions in NAA 5, South Coast.

Primary AI	Total product emissions (tons/day)	% of all NAA 5 May - Oct 2004 emissions
METHYL BROMIDE	0.881	33.7
PERMETHRIN	0.338	12.9
1,3-DICHLOROPROPENE	0.328	12.5
N-OCTYL BICYCLOHEPTENE DICARBOXIMIDE	0.174	6.7
CHLOROPICRIN	0.143	5.5
BIFENTHRIN	0.075	2.9
CHLORPYRIFOS	0.055	2.1
CYPERMETHRIN	0.049	1.9
PIPERONYL BUTOXIDE	0.046	1.8
CYFLUTHRIN	0.038	1.4

TABLE 15: Top ten pesticide application sites contributing to 2004 May-October ozone season VOC emissions in NAA 5.

Application site	Emissions (tons/day)	% of all NAA 5 May - Oct 2004 emissions
STRAWBERRY	1.099	42.0
STRUCTURAL PEST CONTROL	0.892	34.1
FUMIGATION, OTHER	0.176	6.7
LANDSCAPE MAINTENANCE	0.140	5.4
NURSERY OUTDR CONTAINER -FLD GRWN PLANTS	0.064	2.4
RIGHTS OF WAY	0.056	2.2
COMMODITY FUMIGATION	0.040	1.5
SOIL APPLICATION/PREPLANT	0.029	1.1
PEPPERS, FRUITING	0.022	0.8
FOOD PROCESSING/HANDLING PLANT/AREA (ALL / UNSPEC)	0.017	0.6

TABLE 16: 2004 May–October VOC emissions in NAA 5 by ARB emission inventory classification (tons per day, tpd).

	Agricultural applications	Structural applications
methyl bromide emissions	0.876	0.005
non-methyl bromide emissions	0.845	0.889

III. SUMMARY

NAA 1 (Sacramento Metropolitan) and NAA 5 (South Coast) 2004 May-October emissions were the only two regions with emission rates below their respective attainment goals. Emission rates for NAA 1 and NAA 5 also were lower than those found in 2003. On the other hand NAA 2 (San Joaquin Valley) and NAA 4 (Ventura) produced higher emission rates in 2004 and exceeded their attainment goals. Although the emission rate in NAA 3 (Southeast Desert) decreased slightly in 2004, this rate is still well above its attainment goal. These trends hold regardless if 1990 or 1991 is used as the base year, or a 12% or 20% reduction goal is used for San Joaquin Valley. Fumigants were the major sources of emissions in all regions except NAA 1; consequently unless these emissions are significantly reduced, NAA 2, NAA 3, and NAA 4 will continue to fail to meet their goals.

IV. REFERENCES

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cc: Randy Segawa, Agriculture Program Supervisor

Figure 1. Annual ozone season pesticide VOC emissions by NAA. For simplicity and ease of comparison with previous reports, these figures use 1990 as the base year and a 12% reduction for San Joaquin Valley.